



Remote sensors tests on Lithuanian roads

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Overview

- Introduction – RWIS in Lithuania
- Remote sensors test background
- Remote sensors DST111 & DSC111
- DST111 measurements & case studies
- DSC111 measurements & case studies



Introduction – RWIS in Lithuania (1)

- The Lithuanian Road Administration under the Ministry of Transport and Communications of the Republic of Lithuania;
- Lithuania National Significance road network length – **21.320 km**;
- RWIS in Lithuanian since **1998**;
- RWIS includes: **45** Road Weather Stations (RWS), **18** road video cameras (RVC), **4** weather information signs;
- RWS information on the official internet site;

http://www.lra.lt/en.php/traffic_conditions/weather_information/105

- Also in Baltic States and Finish National Road Administration's supported internet site. <http://www.balticroads.net/en/>



Introduction – RWIS in Lithuania (2)

Public Road use

BALTIC ROADS.NET

Welcome to www.balticroads.net service, which is provided in co-operation between the National Road Administrations of Finland, Estonia, Latvia, Lithuania and Russia.

You can see the current road weather conditions in the Baltic Sea Region.

The information is based on automatic Road Weather Information Systems of the concerned countries.

Disclaimer

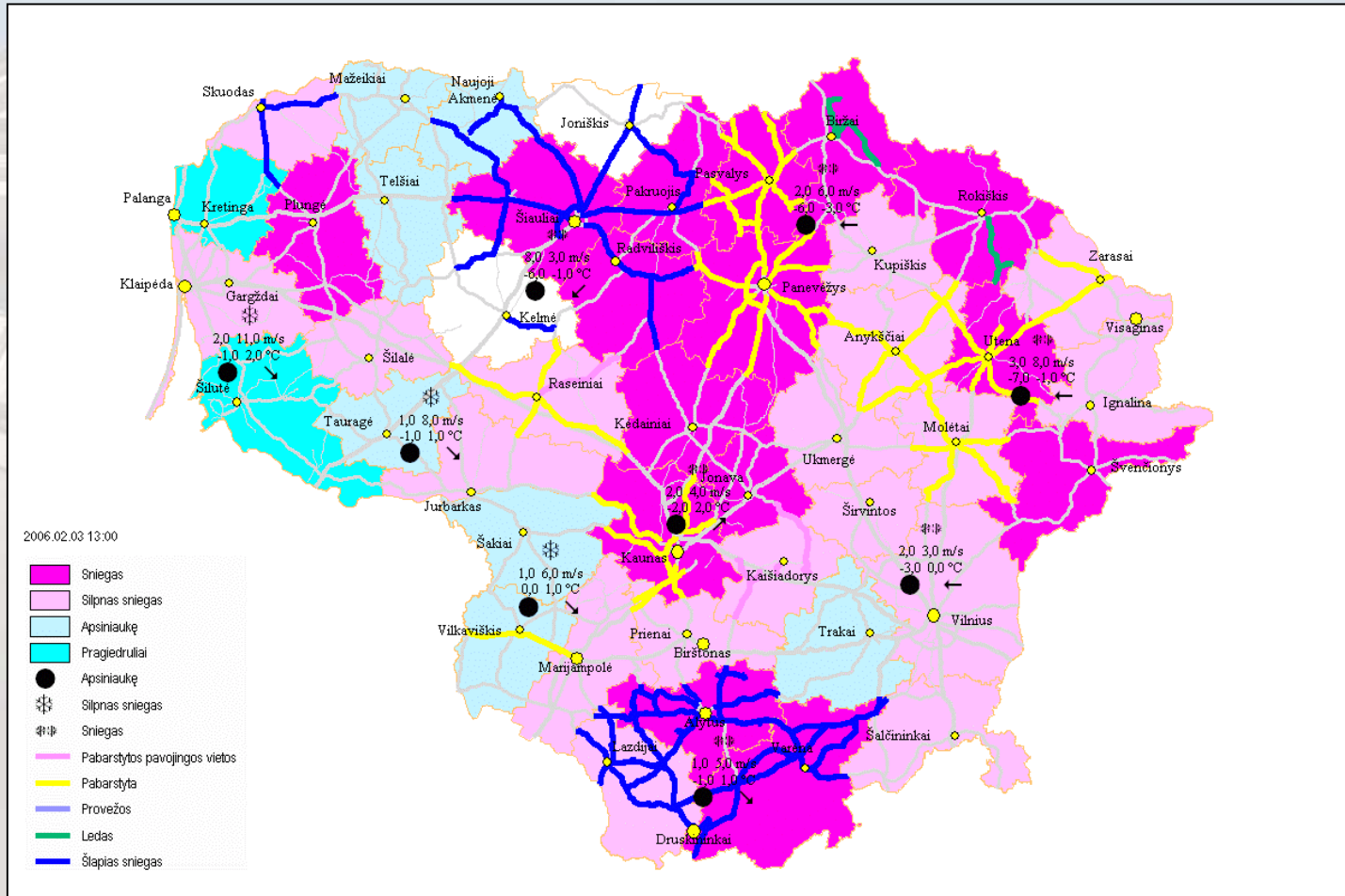
HAVE A SAFE JOURNEY !

- Finnish Road Administration
- Estonian Road Administration
- Latvian Road Administration
- Lithuanian Road Administration
- Leningrad Region Road Committee
- Comments and suggestions for site

Map showing road networks in the Baltic Sea region, including Sweden, Finland, Estonia, Latvia, Lithuania, Russia, Belarus, and Poland. Key cities like Stockholm, Helsinki, Tallinn, Riga, Vilnius, and Minsk are marked. The map highlights road conditions in the Baltic Sea region.



Introduction – RWIS in Lithuania (3)



Weather & Road surface conditions (2006-02-03)



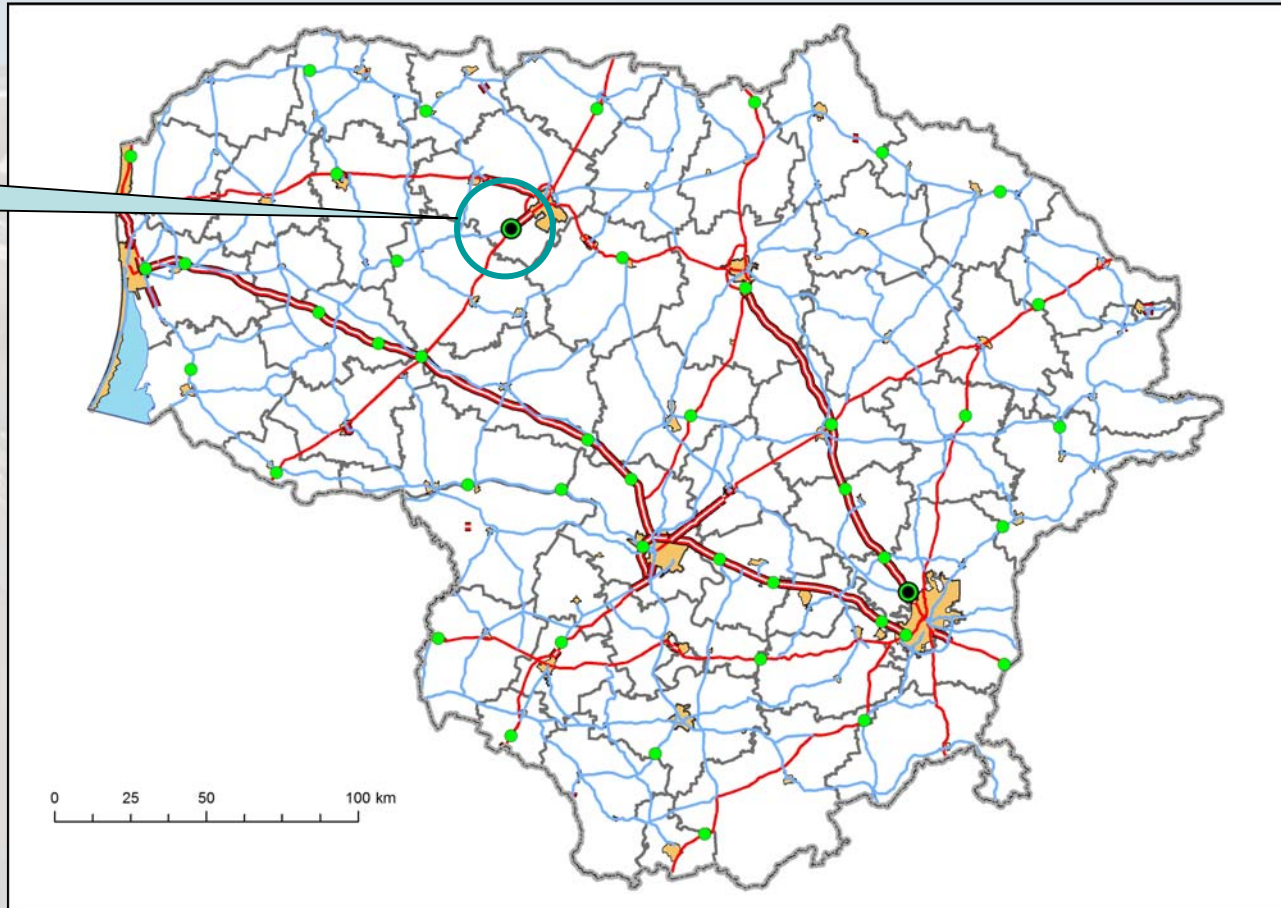
Remote sensors test background (1)

- The **main objective** of Vaisala Oyj's pilot project was to compare data from the remote sensors with RWS, RVC and the periodic field measurements and to evaluate operative potential of these sensors on Lithuanian roads. To achieve this objective the following **tasks** had been defined:
 - Verify applicability and creativity of RWS data;
 - Analyse sensors and equipment specification;
 - Form database and computing programs for further analysis;
 - Perform data comparative study during different weather conditions.
- Pilot project was run from the **6th of December, 2006** to the **17th of April, 2007** (the end of the cold season).



Remote sensors test background (2)

RWS
"Bubiai"

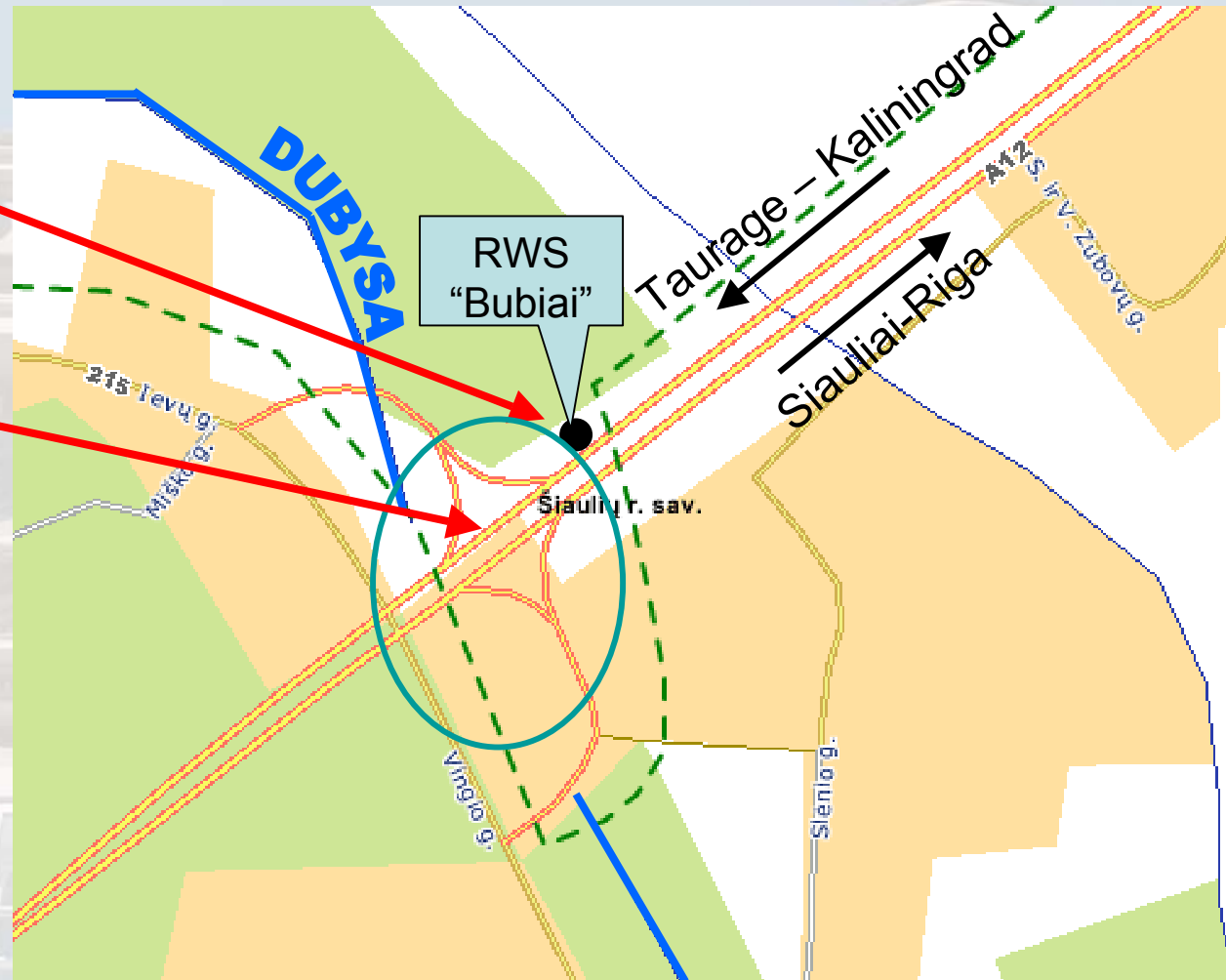


RWS "Bubiai" & DSC111/DST111 sensors on motorway E77 (A12)
Riga – Siauliai – Taurage – Kaliningrad in Northern part of Lithuania



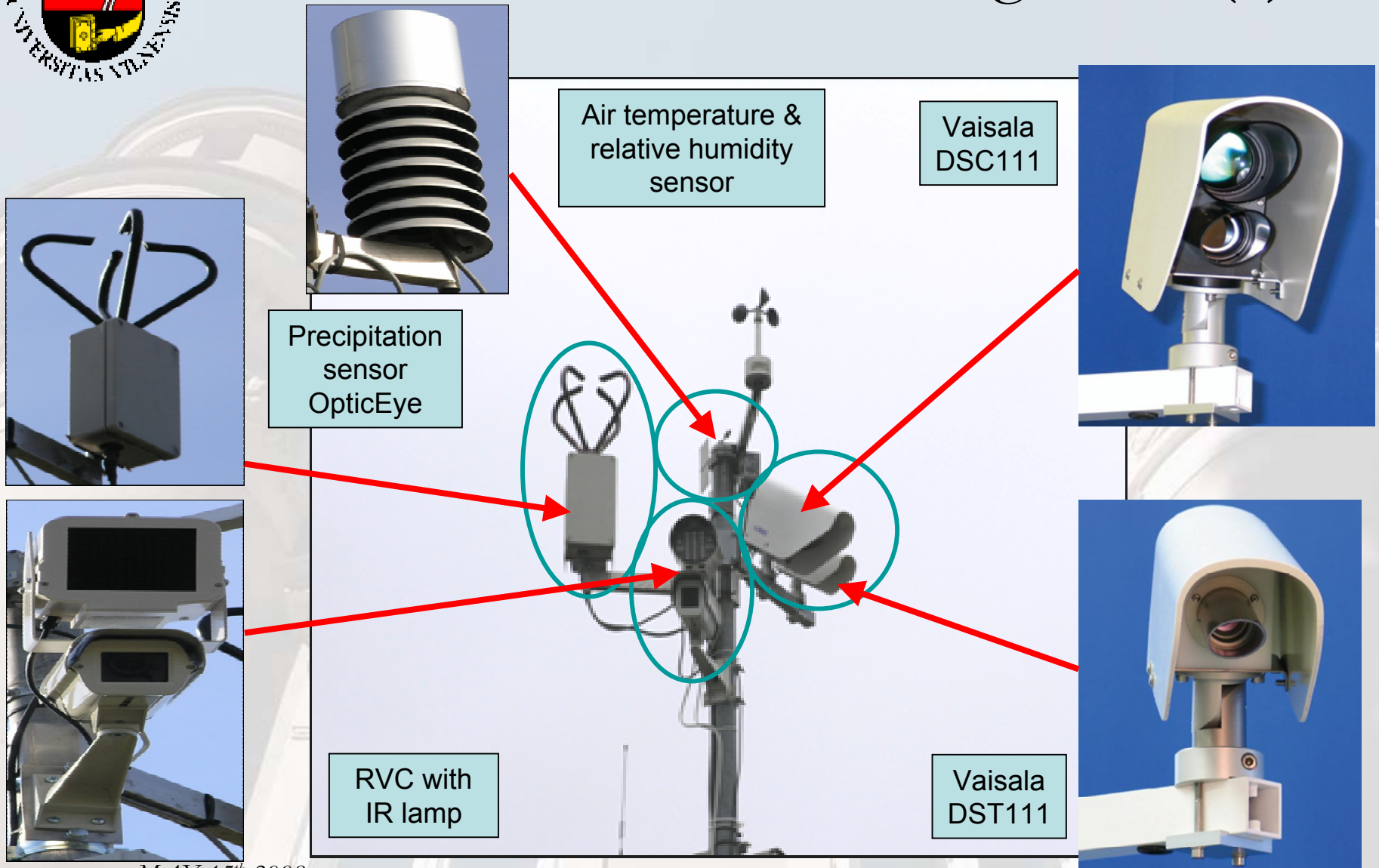
Remote sensors test background (3)

- The right side of the 4 lane road (A12)
- Near the bridge across river Dubysa.





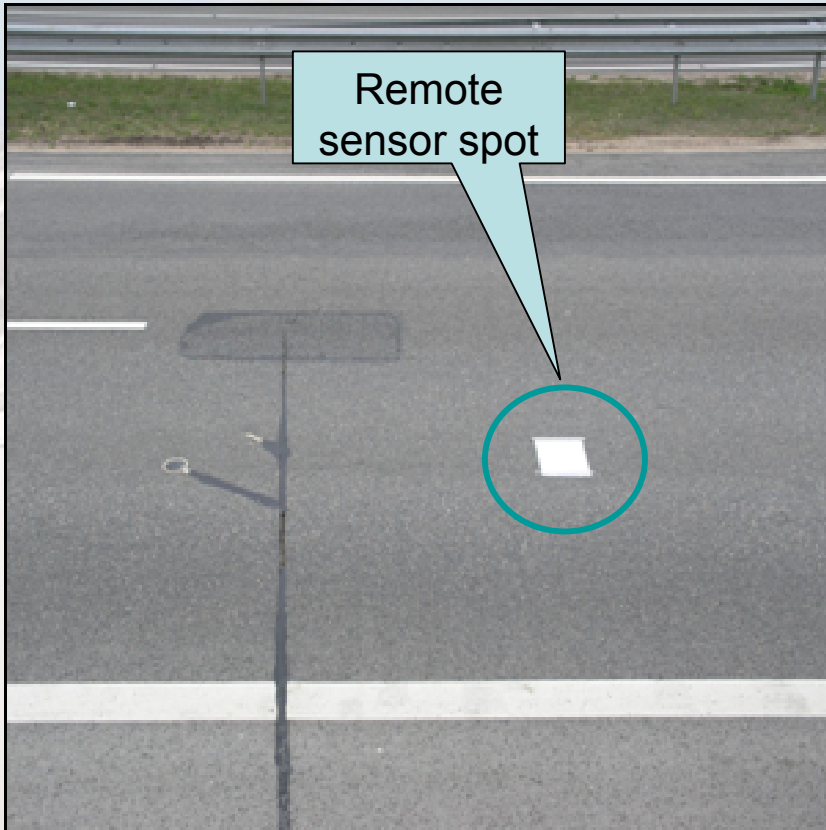
Remote sensors test background (4)



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Remote sensors test background (5)



- The spot of DSC111 remote sensor is on the first lane between the ruts close to right side

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- Visual range of RVC is oriented towards bridge side

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Remote sensors DST111 & DSC111 (1)

Vaisala Remote Road Surface Temperature Sensor DST111:

- Remote temperature measurement (measuring distance 2 ... 15 m, operating temperature -40 ... +60°C, operating humidity 0 ... 100% RH);
- Unique correction of the error caused by the emission of the road surface, negating the need for emission adjustment;
- Easy installation and service;
- Low maintenance costs;
- No internal moving parts;
- Stable measurement results even with intense traffic (resolution 0.1 °C, surface temperature -40 ... +60 °C, time constant 1 min, data refresh time 30 s);
- Weather-proof, durable design;
- Reports air temperature and humidity;
- Easy integration with Vaisala ROSA Road Weather Station;
- Capability to act as stand-alone device in remote locations with solar/gsm option.





Remote sensors DST111 & DSC111 (2)

Vaisala Remote Road Surface State Sensor DSC111:

- Remote surface state sensing (measuring distance 2 ... 15 m, operating temperature $-40 \dots +60^{\circ}\text{C}$, operating humidity 0 ... 100% RH);
- Spectroscopic measuring principle (surface states: dry, moist, wet, snow/frost, ice, slush);
- Unique measurement of grip (level of grip 0.01 ... 1.00);
- Accurate and stable measurement results even with intense traffic (layer thickness: water 0.00 ... 2 mm, ice 0.00 ... 2 mm, snow 0.00 .. 10 mm);
- Eye-safe laser technology (eye-safe, laser class 1);
- Easy installation and service;
- Low maintenance costs;
- Weather-proof, durable design;
- Easy integration with Vaisala ROSA Road Weather Station, or can operate as a standalone solution with solar/GSM options.





Remote sensors DST111 & DSC111 (3)

- Remote sensor's DSC111/DST111 complementing, installing, mounting, calibrating, software updating, maintaining tests **ran mostly well** for Lithuanian conditions.
- Since winter season of 2006-2007 was very short and atypically warm, there is a need for further testing. We need **extra testing** to decide whether the extensive usage of these sensors in Lithuania is necessary.



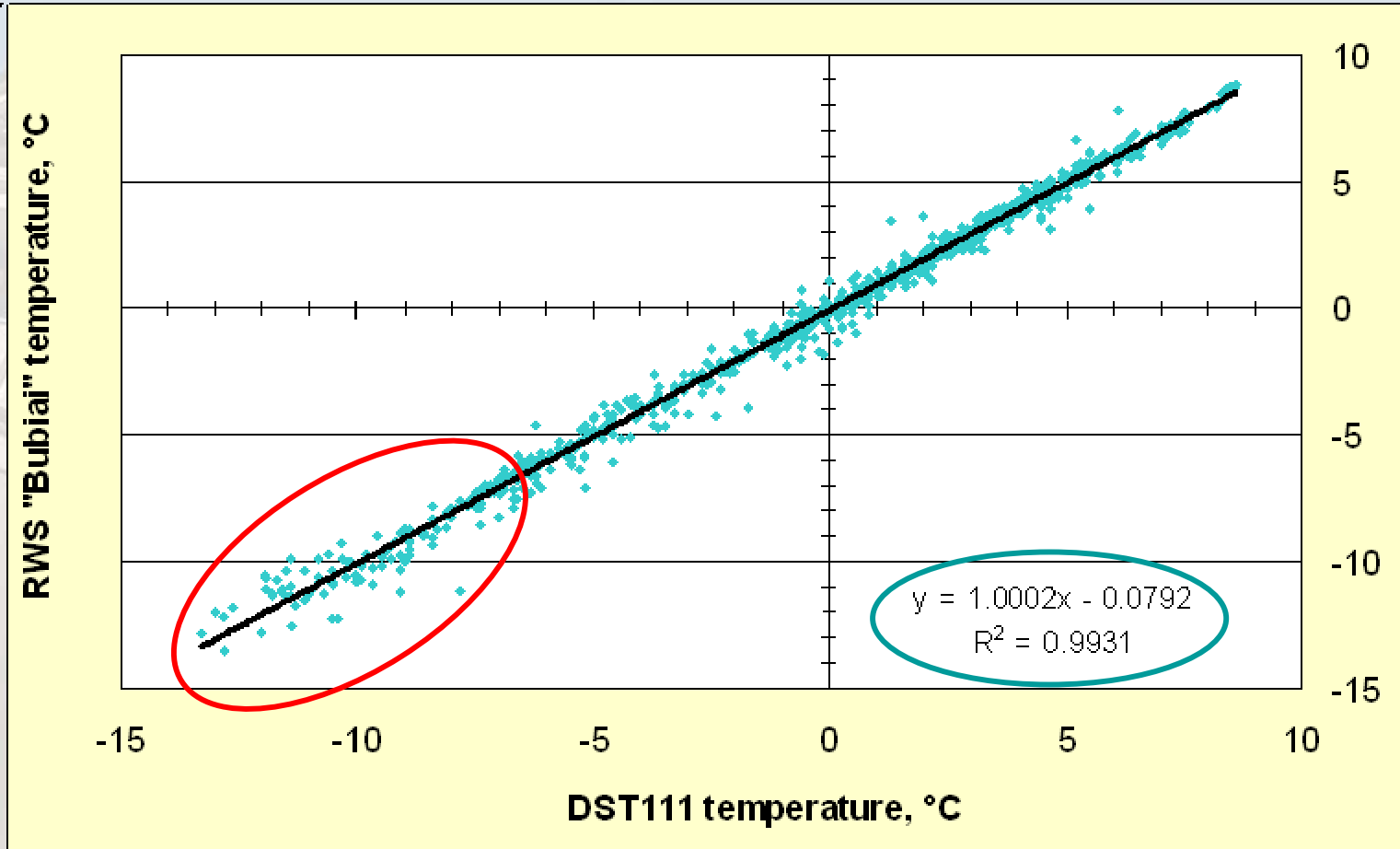
DST111 measurements & case studies (1)

- Air, dew point, road surface temperature differences between RWS “Bubiai” and DST111

	Air, °C	Dew point, °C	Road surface, °C
Mean difference	-0,14	-0,86	0,05
Standard deviation	0,32	0,98	0,60
Mean difference (dangerous conditions)	-0,05	-1,25	0,17
Standard deviation (dangerous conditions)	0,32	0,61	0,54



DST111 measurements & case studies (2)

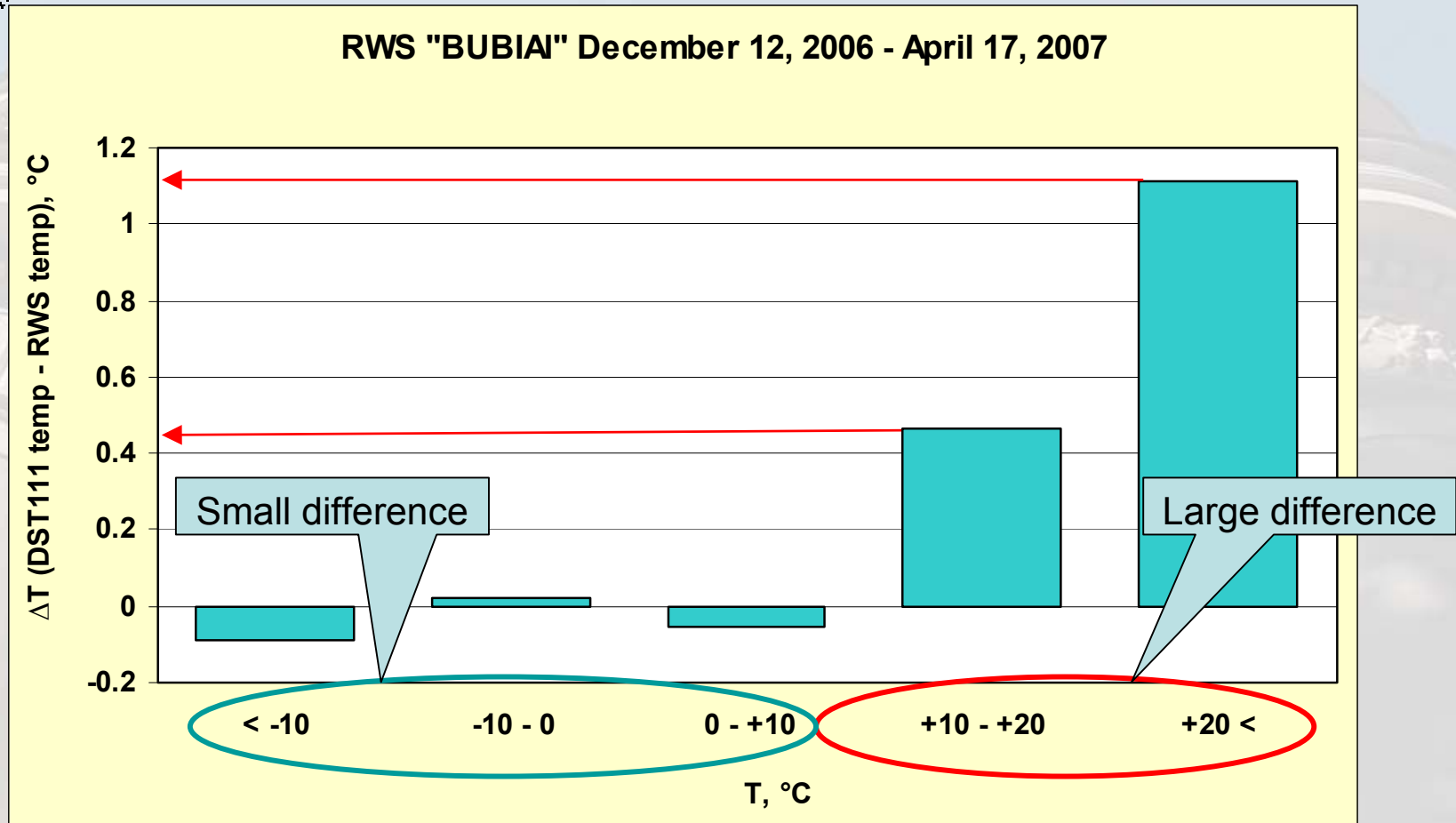


- Relation between RWS "Bubiai" and DST111 measured road surface temperatures

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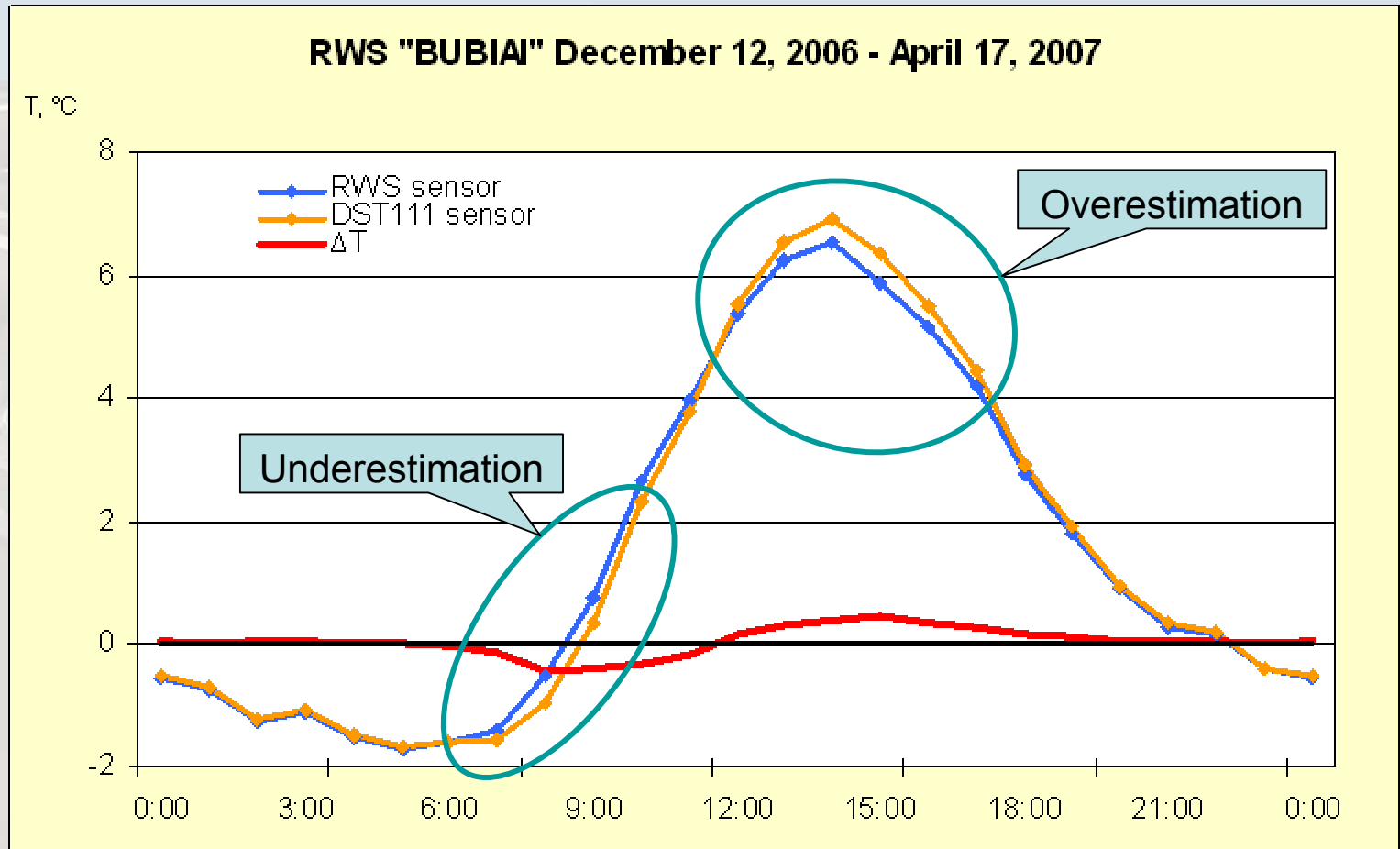
DST111 measurements & case studies (3)



- Measuring difference under different road surface temperature means



DST111 measurements & case studies (4)

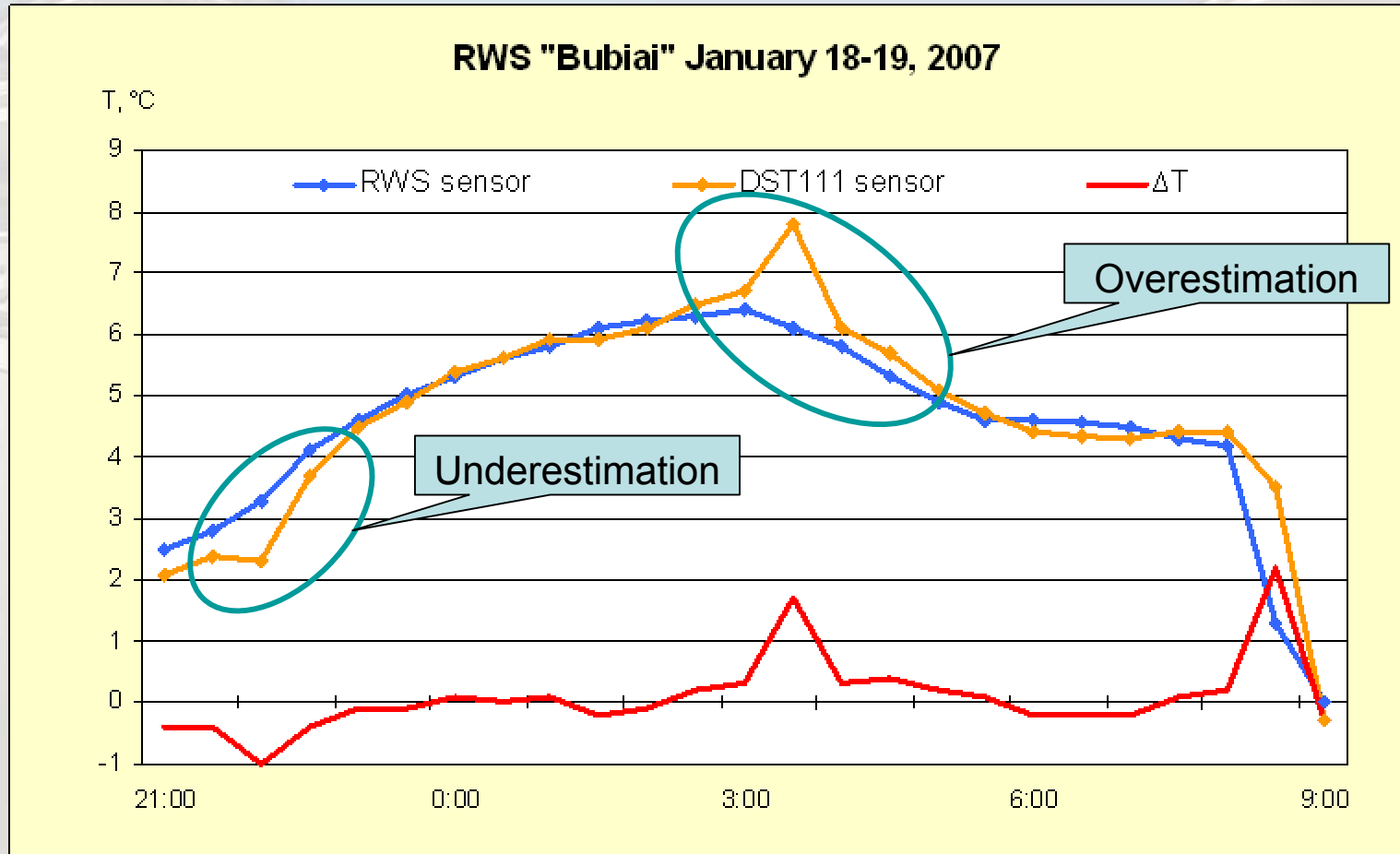


Daily mean road surface temperature flow chart:

- Underestimation: from 7AM to 11AM, max -0.3°C ;
- Overestimation: from 12AM to 5PM, max -0.3°C .

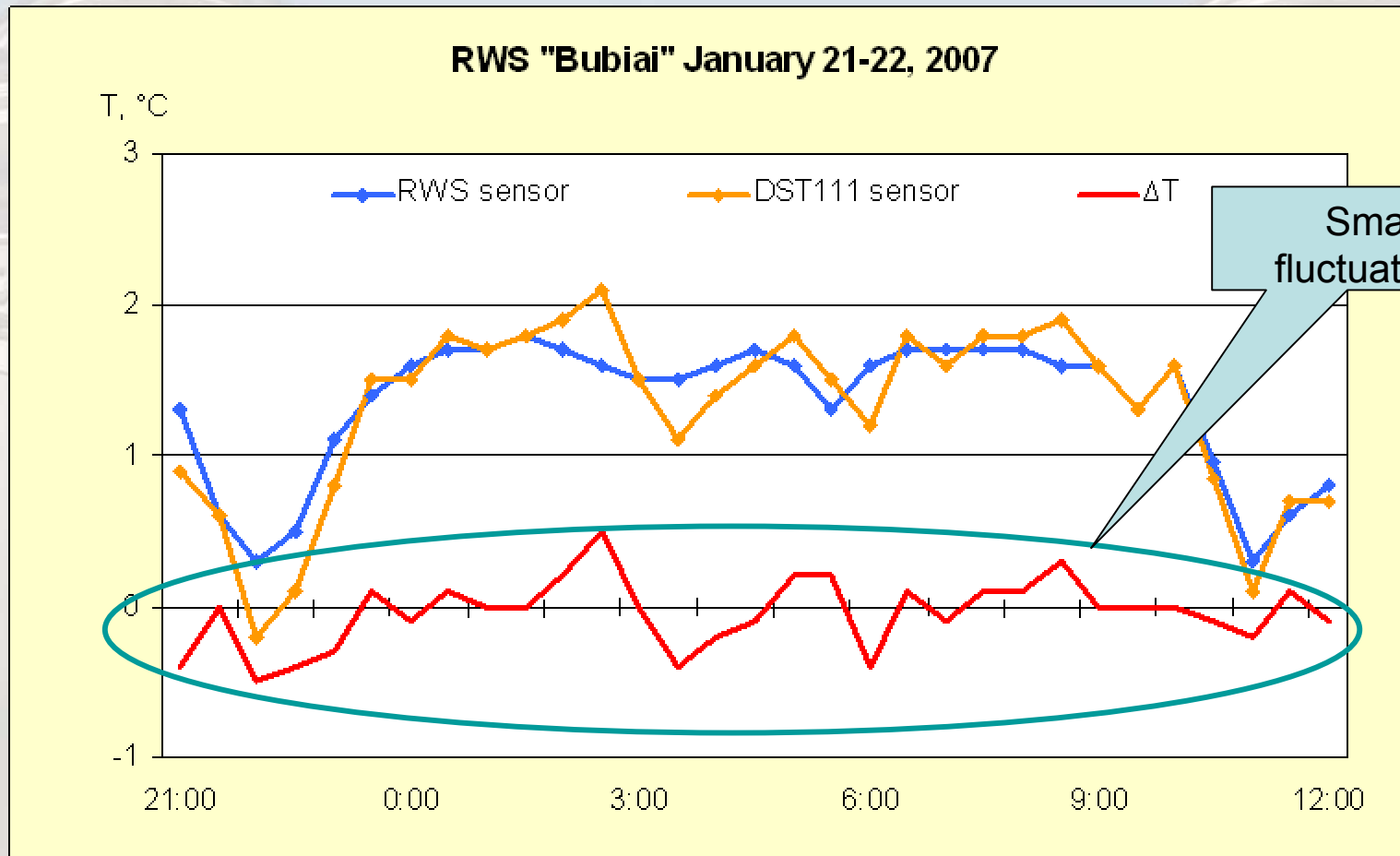


DST111 measurements & case studies (5)



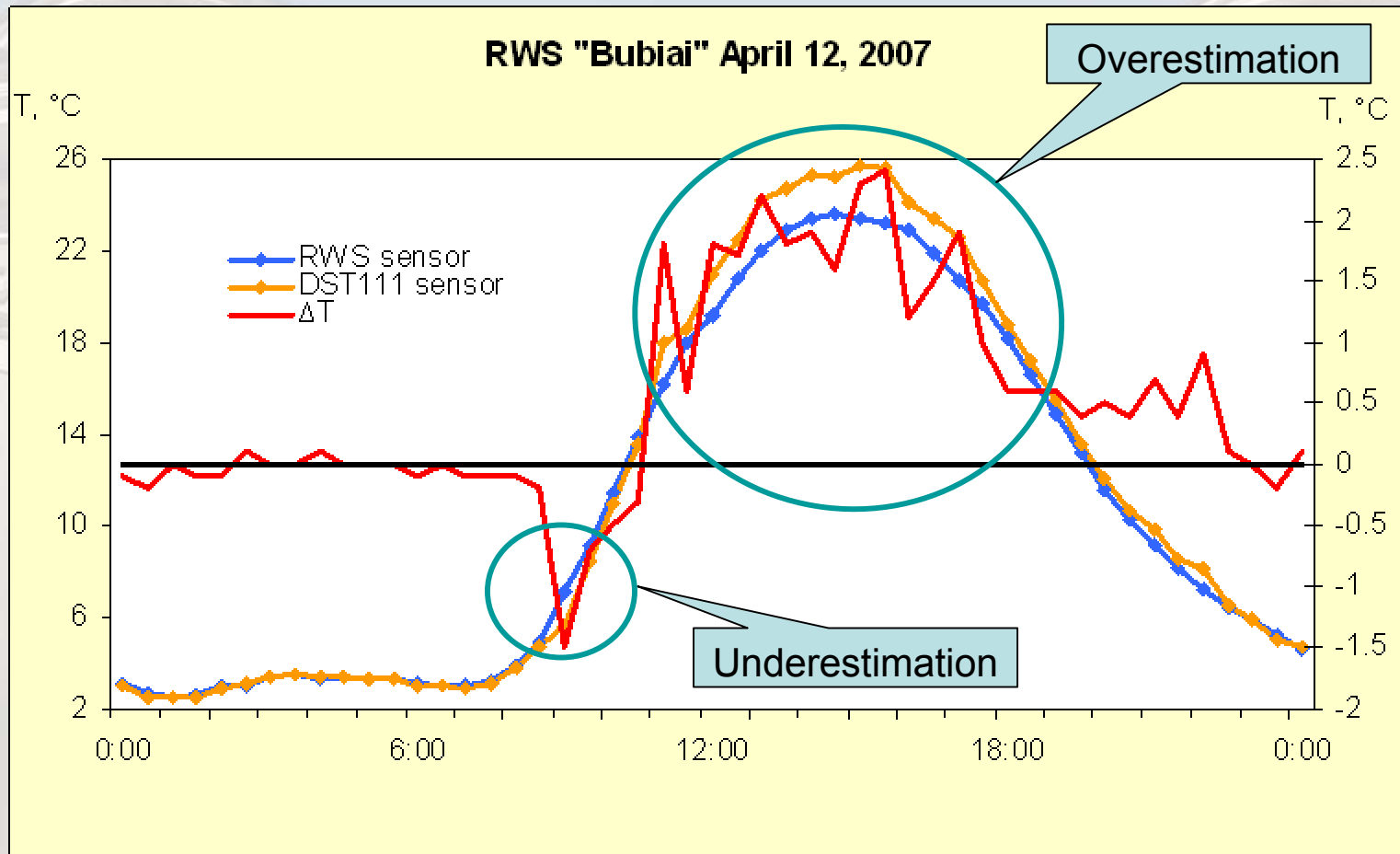


DST111 measurements & case studies (6)





DST111 measurements & case studies (7)





DST111 measurements & case studies (8)

- Road surface temperature values **were very similar** (diff. 0.05°C) if temperatures were below 5°C limit when comparing DST111 and RWS sensor's data.
- Temperature range level was **permissible** (standard dev. 0.6°C) and the data **were possible** to use for road temperature real situation, analysis and forecasting purposes.
- However, when the road surface temperature exceeded 10°C the difference between the two sensors **increased** (even to $4-7^{\circ}\text{C}$). DST111 **had not enough accuracy** in warm period in Lithuania, but this period wasn't important for winter road maintenances specialists.



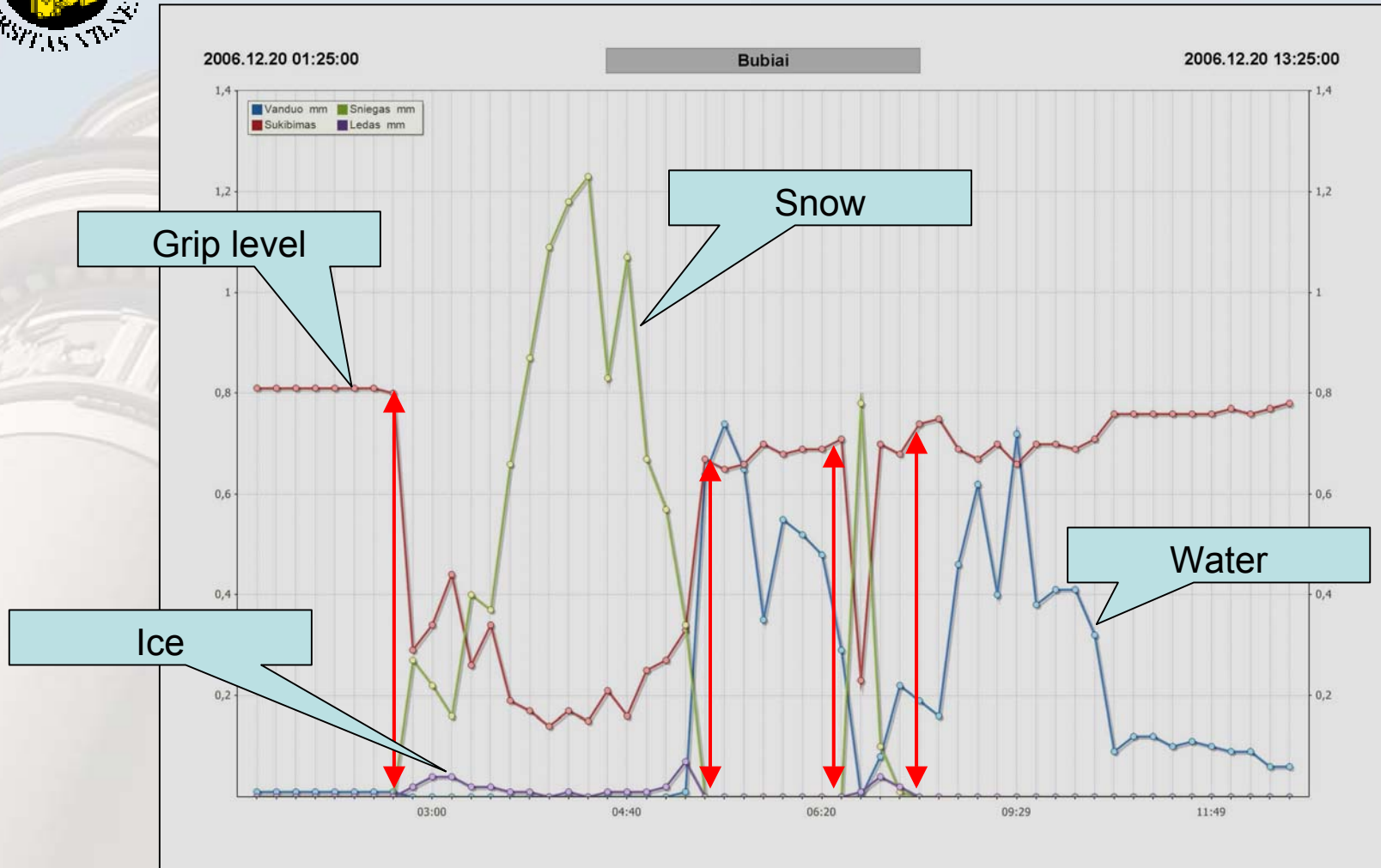
DSC111 measurements & case studies (1)

Mismatch cases for RVC and DSC111 data under different road surface conditions

Road surface conditions	RVC		DSC111	
	Mismatch / Overall		Mismatch / Overall	
Dry	4 / 245	2%	34 / 275	12%
Damp / Wet	13 / 183	7%	144 / 314	46%
Slush / Snow / Ice	138 / 474	29%	7 / 343	2%



DSC111 measurements & case studies (2)



Grip level and road surface conditions measured by DSC111 (2006-12-20)

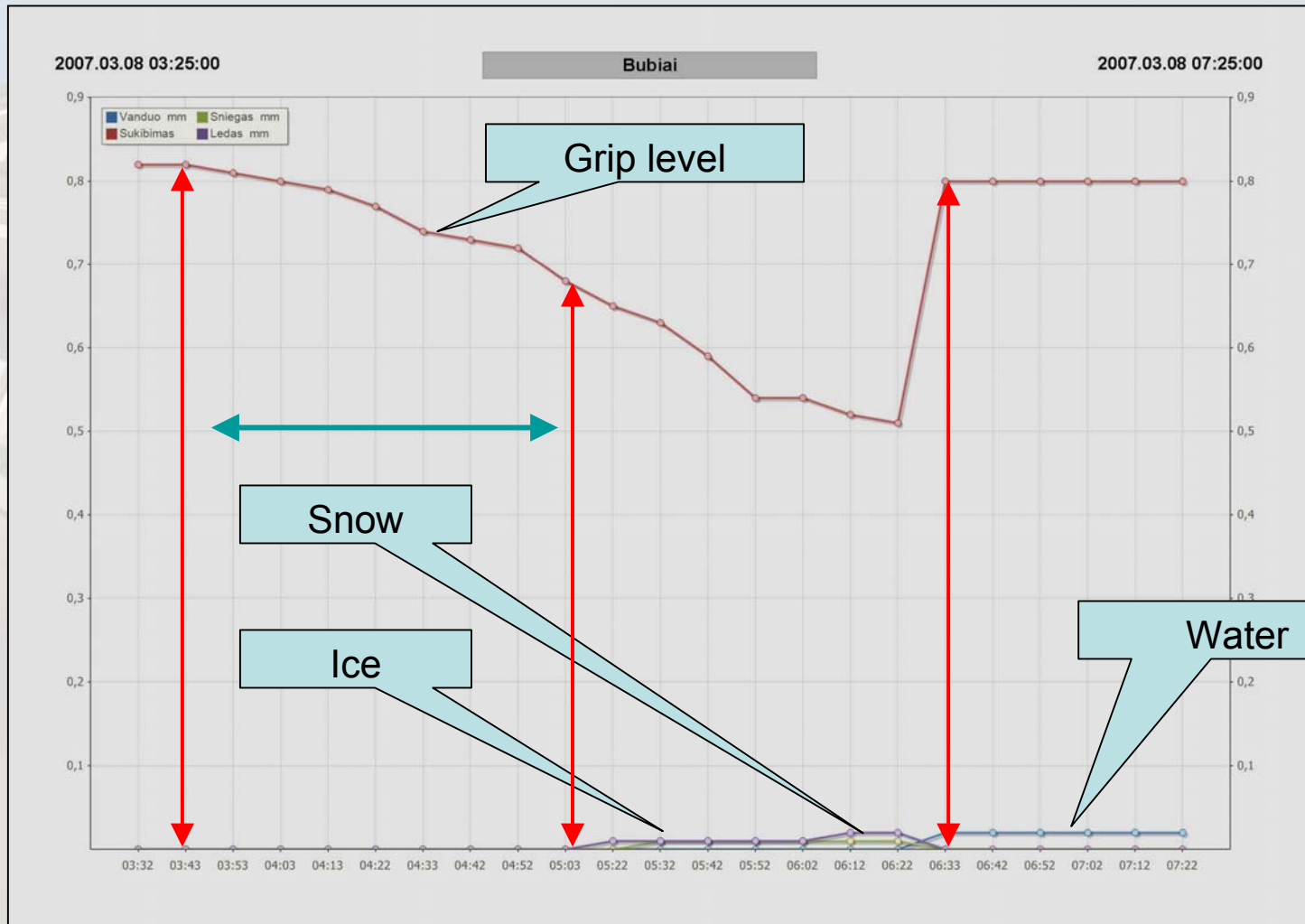
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DSC111 measurements & case studies (3)



Grip level and road surface conditions measured by DSC111 (2007-03-08)

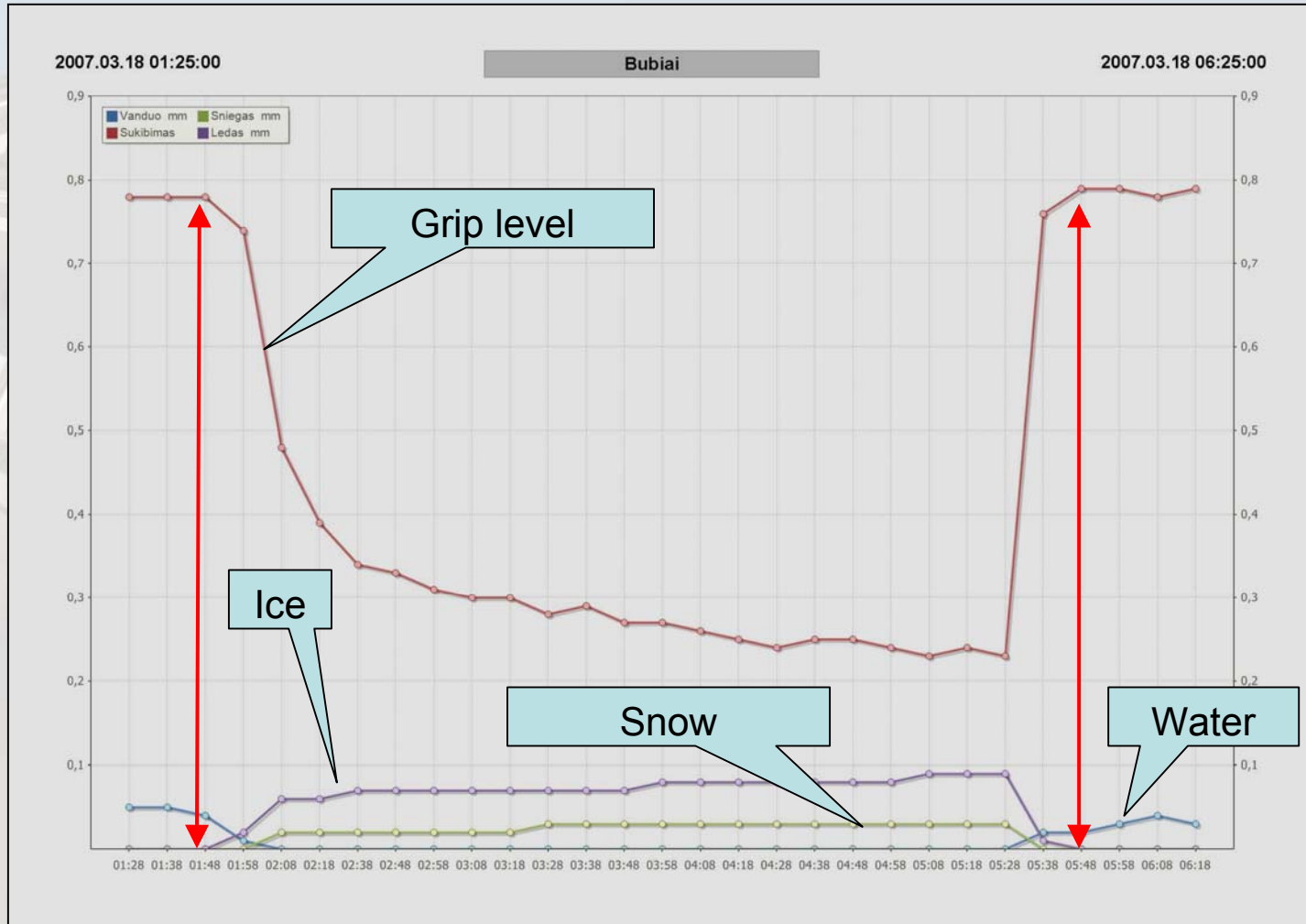
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DSC111 measurements & case studies (4)



Grip level and road surface conditions measured by DSC111 (2007-03-18)

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DSC111 measurements & case studies (5)

Remote sensor DSC111 variables of road **surface state**:

- 1- dry, 2 – damp, 3 - wet, 6 – snow, 7 – ice, 9 – slush.

Precipitation type from RWS “Bubiai” data:

- 1 - no precipitation, 2 – rain, 3 – freezing rain, 4 - snow, 6 – sleet, 7 – snowstorm.

Road surface conditions from **RVC** (CCTV):

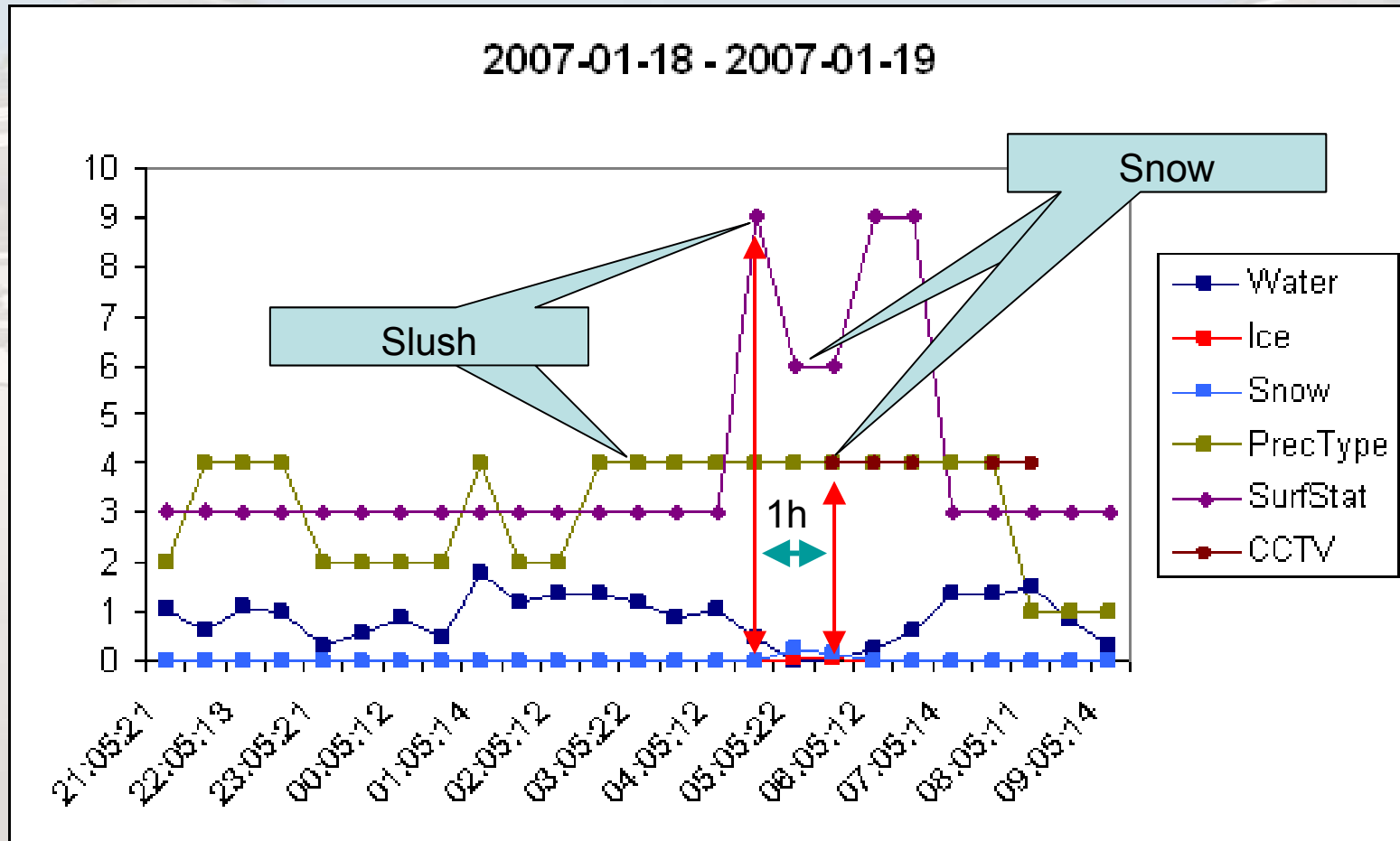
- 1 - dry, 2 – damp, 3 – wet, 4 – snow, 5 – slush.

6 variables were derived:

- **Water** - water film thickness, mm;
- **Ice** - ice thickness, mm;
- **Snow** - snow thickness, mm;
- **PrecType** – precipitation type from RWS “Bubiai” varying from 1 to 7;
- **SurfState** – road surface state from DSC111 varying from 1 to 9;
- **CCTV** - RVC data varying from 1 to 5.

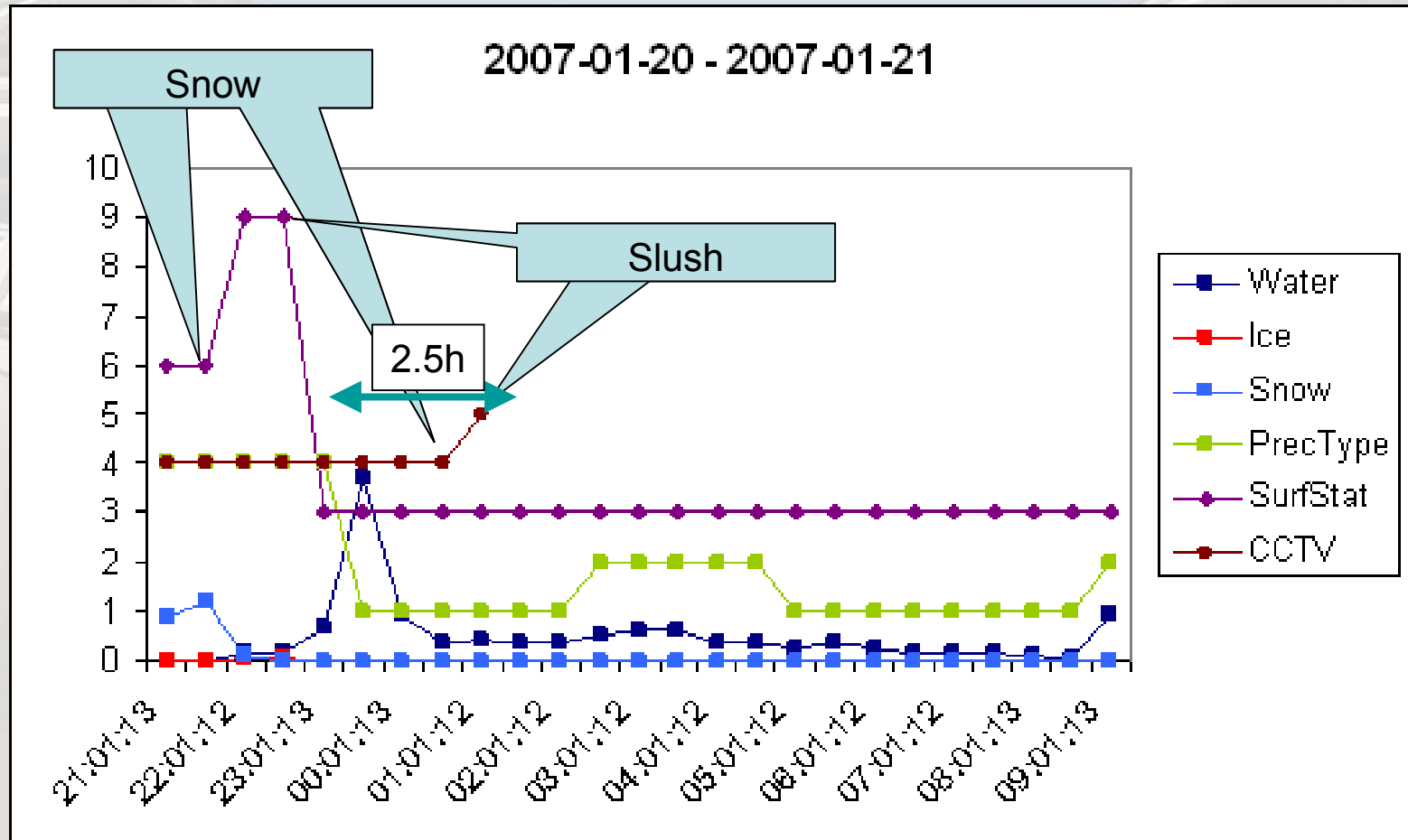


DSC111 measurements & case studies (6)



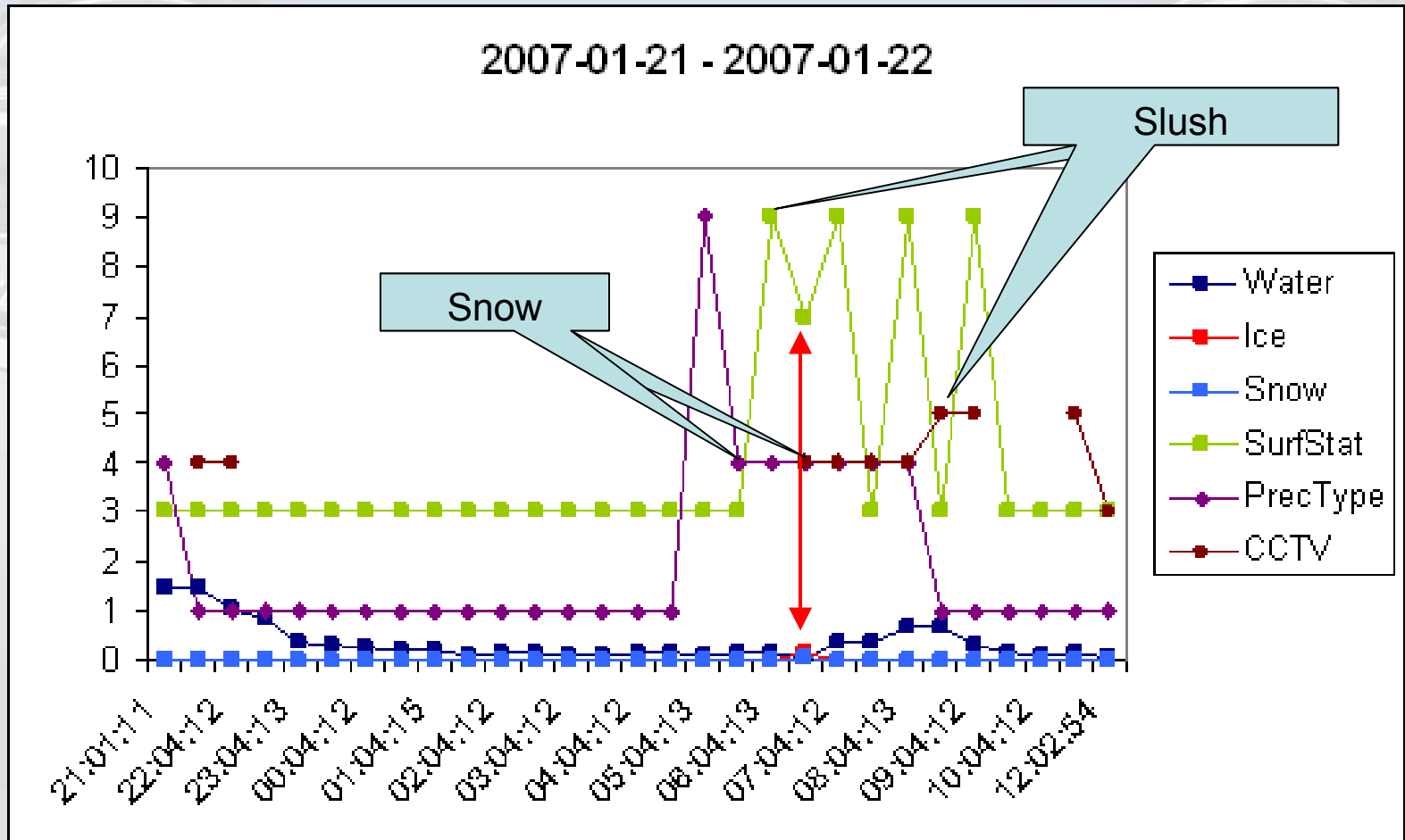


DSC111 measurements & case studies (7)





DSC111 measurements & case studies (8)





DSC111 measurements & case studies (9)

- Remote sensor DSC111 data **were mostly correct and representative** when compared with RVC measurements. Especially when road surface conditions were dry.
- The **most inadequate** results were under heavy driving conditions (wet / damp / ice / rammed snow on road surface). First reason was that the remote sensor **was able** to recognize **0.01 mm** thick water film on the road's surface which other devices **could not** spot. And the other reason was that the remote sensor has a **narrow-gauge field** of view which **was decreasing** under snow conditions compared to the road surface size.
- Also measurements may differ because of **an inadequacy** of thermal road conditions and **diverse spread** of salt on the road surface.



Acknowledgments to:

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Thank you for your attention!